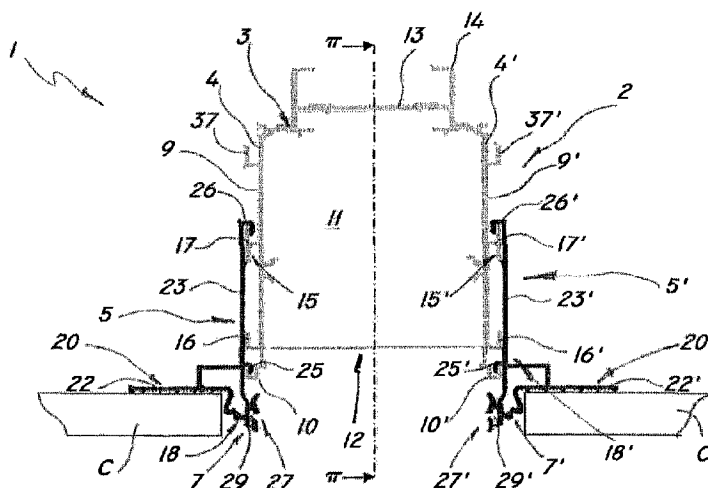




(86) Date de dépôt PCT/PCT Filing Date: 2012/10/04
(87) Date publication PCT/PCT Publication Date: 2013/04/11
(45) Date de délivrance/Issue Date: 2023/02/28
(85) Entrée phase nationale/National Entry: 2014/04/03
(86) N° demande PCT/PCT Application No.: IB 2012/055336
(87) N° publication PCT/PCT Publication No.: 2013/050963
(30) Priorité/Priority: 2011/10/05 (IT VI2011A000268)

(51) Cl.Int./Int.Cl. *E04B 9/24* (2006.01),
E04B 9/00 (2006.01), *E04B 9/06* (2006.01),
E04B 9/26 (2006.01)
(72) Inventeur/Inventor:
GRANDI, RUGGERO, IT
(73) Propriétaire/Owner:
GEMINO S.R.L., IT
(74) Agent: ROBIC

(54) Titre : SYSTEME MODULAIRE POUR SOUS-PLAFOND
(54) Title: MODULAR SYSTEM FOR SUB-CEILINGS



(57) Abrégé/Abstract:

A modular system for a sub-ceiling composed of a plurality of substantially horizontal side-by-side panels (P, P'), comprises a plurality of beams (2, 2'), which are designed to be secured to a floor in substantially horizontal positions, each beam (2, 2') having a substantially U-shaped cross section, with a pair of substantially vertical side walls (4, 4'), and a plurality of interface members (5, 5'; 6, 6') which are designed to be coupled to said side walls (4, 4') for securing respective sub-ceiling panels (P, P') to each of the beams (2, 2'). The interface members (5, 5'; 6, 6') have quick connection means (7, 7'; 8, 8') for snap connection with no universal connection members to the outer side surfaces (9, 9') of the substantially vertical side walls (4, 4'). Each beam (2, 2') has at least one pair of lateral connecting members (15, 15') outwardly projecting and each firmly associated with a respective substantially vertical lateral wall (4, 4').

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property
Organization
International Bureau



(10) International Publication Number
WO 2013/050963 A3

(43) International Publication Date
11 April 2013 (11.04.2013)

(51) International Patent Classification:

E04B 9/24 (2006.01) *E04B 9/00* (2006.01)
E04B 9/26 (2006.01) *E04B 9/06* (2006.01)

(21) International Application Number:

PCT/IB2012/055336

(22) International Filing Date:

4 October 2012 (04.10.2012)

(25) Filing Language:

Italian

(26) Publication Language:

English

(30) Priority Data:

VI2011A000268 5 October 2011 (05.10.2011) IT

(71) Applicant: GEMINO S.R.L. [IT/IT]; Via Vergerio, 17, I-35126 Padova (PD) (IT).

(72) Inventor: GRANDI, Ruggero; Via Palladio, 8, I-36050 Quinto Vicentino (VI) (IT).

(74) Agent: MAROSCIA, Antonio; Maroscia & Associati S.r.l., Contrà Porti, 21, I-36100 Vicenza (IT).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT,

HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

- with international search report (Art. 21(3))
- before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))

(88) Date of publication of the international search report:

13 June 2013

(54) Title: MODULAR SYSTEM FOR A SUB -CEILING

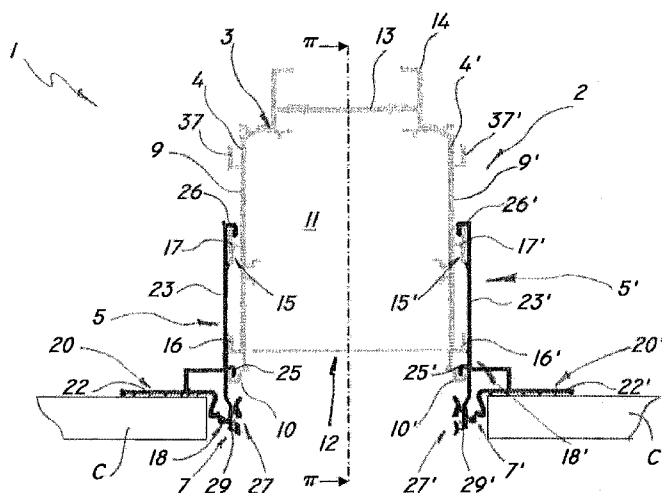


FIG. 1

(57) Abstract: A modular system for a sub-ceiling composed of a plurality of substantially horizontal side-by-side panels (P, P'), comprises a plurality of beams (2, 2'), which are designed to be secured to a floor in substantially horizontal positions, each beam (2, 2') having a substantially U-shaped cross section, with a pair of substantially vertical side walls (4, 4'), and a plurality of interface members (5, 5'; 6, 6') which are designed to be coupled to said side walls (4, 4') for securing respective sub-ceiling panels (P, P') to each of the beams (2, 2'). The interface members (5, 5'; 6, 6') have quick connection means (7, 7'; 8, 8') for snap connection with no universal connection members to the outer side surfaces (9, 9') of the substantially vertical side walls (4, 4'). Each beam (2, 2') has at least one pair of lateral connecting members (15, 15') outwardly projecting and each firmly associated with a respective substantially vertical lateral wall (4, 4').

MODULAR SYSTEM FOR SUB-CEILINGS**DESCRIPTION**Field of the invention

The present invention generally finds application in the civil or
5 industrial building industry and particularly relates to a modular system for
forming sub-ceilings.

Background art

In modern buildings, prefabricated room partitions, particularly in
rooms designed for office use, as well as sub-ceilings, are known to be
10 critical elements for both aesthetic and technical purposes.

Particularly, in addition to providing adequate comfort in terms of
acoustic and/or thermal insulation, modern room partitioning systems are
required to have a highly attractive appearance.

Therefore, there is a strong need for sub-ceilings that might appear
15 as linear as possible, with no construction elements projecting out of the
exposed surface, providing a visually seamless result.

The use of sub-ceilings allows concealment of the cables and pipes
that are used for serving the equipment required for adequate comfort of
the room.

20 Typically, a sub-ceiling consists of a modular system having a
plurality of supporting beams which define a texture having two horizontal
rows, with covering panels or plates secured thereto.

The sub-ceiling may also be fitted with functional elements such as
lamps, fire or emergency systems, as well as prefabricated or glazed walls
25 if the available space has to be divided into two or more rooms.

Further examples of similar sub-ceiling systems are disclosed, for
instance, in EP0464367 and EP0627532, in which a sub-ceiling system
comprises a plurality of load-bearing beams which are adapted to be
secured to a floor and have a load-bearing profile with an inverted U-
30 shaped cross section, for accommodating the desired wiring and service
devices.

Each beam also has a pair of lateral wings, horizontally projecting

out of the vertical walls of the beam to define a support for the edges of the panels that are designed to form the sub-ceiling.

Furthermore, panels having technical functions may be secured by means of anchor structures, which are adapted to be fixed to the side of the beam, to provide adequate support to the panels.

These solutions suffer from the common drawback of contributing to form a sub-ceiling which will be generally formed of a plurality of panels with the bearing beams projecting therefrom in a more or less visible manner.

Thus, the construction so obtained will have a lower aesthetic quality, caused by discontinuities in the sub-ceiling.

Furthermore, prior art solutions provide relatively complex structures with a great number of components, requiring long and difficult assembly procedures and heavier structures, with difficult maintenance.

WO2009/153674, by the Applicant hereof, discloses a modular system for forming sub-ceilings which incorporates a plurality of multifunctional beams designed to accommodate a plurality of different functional devices in modular fashion, such as lamps or support elements for partition walls, so that such devices are always entirely incorporated in the U-shaped profile, thereby providing sub-ceilings of high aesthetic value.

Nevertheless, these solutions do not allow modular coupling of sub-ceiling panels of different types, such as metal or plasterboard panels, unless the beam profile is specially adapted.

Therefore, these systems have a poor configuration flexibility, and involve a more complex construction of the sub-ceiling.

Disclosure of the invention

The object of the present invention is to overcome the above drawbacks, by providing a modular system for forming sub—ceilings that is highly modular and flexible in its configuration.

A particular object is to provide a modular system for sub-ceilings that allows simple and quick mounting of different types of panels to the same load-bearing beam.

Yet another object of the present invention is to provide a modular sub-ceiling system that affords the formation of sub-ceilings of superior aesthetic quality with no elements projecting out of the plane defined by the sub-ceiling.

Another important object of the present invention is to provide a sub-ceiling structure that ensures high versatility, to adapt to various uses and different partitioning arrangements in the space covered by the false ceiling.

These and other objects, as more clearly shown hereafter, are fulfilled by a modular system for sub-ceilings, wherein a sub-ceiling is composed of a plurality of substantially horizontal side-by-side panels, comprising a plurality of beams, which are designed to be secured to a floor in substantially horizontal positions, each beam having a substantially U-shaped cross section, with a pair of substantially vertical side walls, and a plurality of interface members which are designed to be coupled to said side walls for securing respective sub-ceiling panels to each of said beams.

The interface members have quick connection means for snap connection with no universal connection members to the outer side surfaces of said substantially vertical lateral walls.

The system is characterized in that the each of said beams has at least one pair of lateral connecting members outwardly projecting and each firmly associated with a respective substantially vertical lateral wall.

With this particular combination of features, the system affords simple and quick mounting of panels of different configurations to the beams, without requiring complex mechanical fixation of the panels to the profile of the beam, thereby allowing remodulation of the entire system.

An embodiment consists of a modular system for a sub-ceiling formed by a plurality of substantially horizontal panels placed in adjacent positions, wherein the system comprises:

- a plurality of beams anchorable to a ceiling in substantially horizontal positions and each having a substantially "U"-shaped cross section with a pair of lateral walls and a substantially vertical symmetry plane (π);
- a plurality of interface members adapted to be coupled with said lateral walls for anchoring of respective sub-ceiling panels to each of said beams;

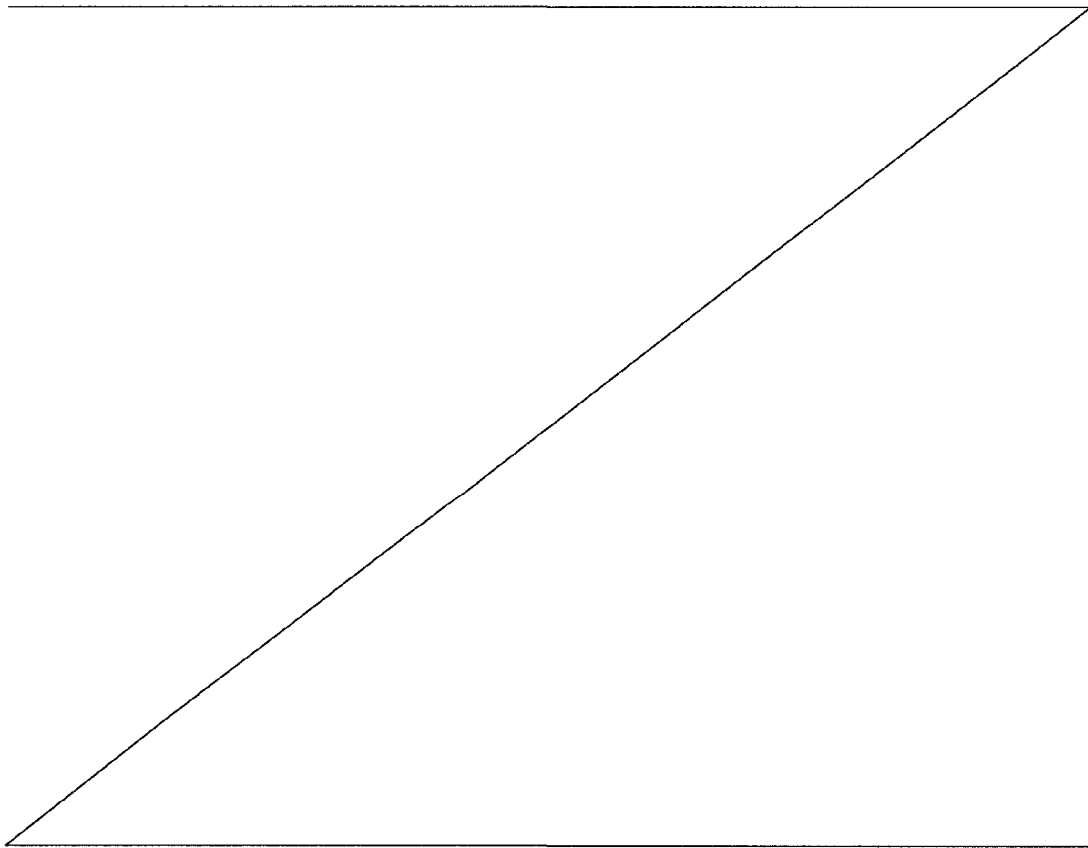
wherein said interface members have quick connection means for snap connection to the outer side surfaces of said substantially vertical lateral walls;

wherein each of said beams has at least one pair of lateral connecting members outwardly projecting and each firmly associated with a respective substantially vertical lateral wall, each of said connecting members being integral with the outer side surface of the corresponding lateral wall; and

in that said quick connection means comprise, for each of said interface members a substantially longitudinal anchoring portion for coupling with one of said lateral connecting members and a support portion adapted to support at least one panel.

Brief description of the drawings

Further characteristics and advantages of the invention will become more apparent upon reading the following detailed description of a few



preferred non exclusive embodiments of a portion of a modular system for forming a sub-ceiling according to the present invention, which are described by way of a non limiting example with the help of the accompanying drawings in which:

5 FIGS. 1 to 3 are cross-sectional views of a beam coupled to a pair of interface members according to three different configurations of the system of the invention;

 FIG. 4 is an enlarged view of a detail of FIG. 3;

 FIGS. 5 and 6 are sectional views of two different configurations of
10 an interface member of a system of the invention;

 FIG. 7 is a cross-sectional view of a portion of a modular system of the invention in a fourth configuration;

 FIGS. 8 to 9 are cross sectional views of two connection profiles of the system according to the configuration of Fig. 6.

15 Detailed description of a preferred embodiment

 Referring to the above figures, a modular system of the invention, generally designated by numeral 1, may be used for forming sub-ceilings composed of a plurality of panels P, C in side-by-side relation, in premises to be divided into multiple rooms by prefabricated walls, glazed panels,
20 curtains, or the like.

 Particularly, the system 1 may be assembled in a multiplicity of configurations, with no particular limitation neither in type nor in size, and may include a plurality of load bearing beams 2, 2',... secured to a floor in substantially horizontal positions and a plurality of panels P, C supported
25 by the beams 2, 2' in substantially horizontal positions.

 As shown in Figs. 1 to 3, each beam 2 comprises a substantially longitudinal load-bearing profile 3 having a substantially inverted U-shaped cross section with substantially vertical side walls 4, 4', which are symmetric with respect to a substantially longitudinal and vertical plane π .

30 Each load-bearing profile 3 is designed to be suspended from a floor by steel cables or the like, not shown because they are known per se and are not part of the invention.

The modular system 1 also comprises a plurality of interface members 5, 5'; 6, 6', which are adapted to be coupled with the side walls 4, 4' for securing respective sub-ceiling panels (P, C) to one or more beams 2, 2'.

- 5 For simplicity, the description of the interface members 5, 6 as given below also applies in a substantially identical manner to the corresponding interface members 5', 6'.

According to a peculiar characteristic of the invention, each interface member 5, 6 has quick connection means 7, 8 for snap connection with no
10 universal connection members to the outer side surfaces 9, 9' of the substantially vertical side walls 4, 4'.

The vertical side walls 4, 4' of each load-bearing profile 3 have respective free lower longitudinal edges 10, 10' to define a longitudinal compartment 11 with a bottom opening 12 for receiving one of more
15 functional devices in the compartment 11, such as lamps, support elements for room partitioning panels or the like, not shown in detail and not covered by the scope of the invention.

The vertical walls 4, 4' are also joined at their top by a substantially flat top wall 13, to define the inverted U-shaped load-bearing profile 3.

- 20 The top wall 13 also has a specially shaped portion 14, e.g. also having a U-shape, for attachment thereof to hangers or similar systems which are designed to hold the beam 2 suspended from the floor.

Preferably, the beams 2, 2' are substantially similar and made of metal, e.g. aluminum or similar materials, or polymer materials or
25 composites, by extrusion.

Therefore, the description of one of the beams 2, 2' of the system 1 as given below shall apply in a substantially identical manner to all the other beams, unless otherwise stated.

Each of the side walls 4, 4' of the profiles 3 comprises a lateral
30 connection element 15, 15' which projects out of a corresponding side wall 4, 4' and preferably extends throughout the longitudinal extension of the corresponding beam 2.

Conveniently, the lateral connection elements 15, 15' are integral with the outer side surfaces 9, 9' of corresponding side walls 4, 4' and are formed of one piece therewith, e.g. by extrusion of the same base material.

Each pair of lateral connection elements 15, 15' further comprises a pair of first lower and upper longitudinal projections 16, 16'; 17, 17', which are mutually offset by a first predetermined distance d_1 in a substantially vertical direction.

Advantageously the first lower longitudinal projections 16, 16' of the connection elements 15, 15' define the bottom opening 12 of the load-bearing profile by their inner edges 3.

As more clearly shown in Figs. 5 and 6, for each interface member 5, 6, the quick connection means 7, 8 include substantially longitudinal and vertical anchor portions 18, 19 which are designed to mate with respective lateral connection elements 15, 15'.

The interface members 5, 6 further include respective substantially longitudinal support portions 20, 21 which are adapted to stably support at least one sub-ceiling panel P, C.

According to a peculiar characteristic of the invention, the interface members 5, 6 have respective anchor portions 18, 19, which are substantially identical and shaped to mate with any one of the lateral connection elements 15, 15' of any one of the beams 2 designed to form the modular system 1.

Furthermore, at least one of the interface members 5, as shown in Fig. 5, has a support portion 20 for supporting a plasterboard sub-ceiling panel C. At least one of the interface members 6, as shown in Fig. 6, has a support portion 21 for supporting a metal sub-ceiling panel P.

Thus, each beam 2 may have coupled thereto either a pair of interface members 5, 5' for plasterboard panels C, as shown in Fig. 1, or a pair of interface members 6, 6' for metal panels P, as shown in Fig. 2.

Furthermore, a beam 2 may be simultaneously fitted with two interface members 5, 6 of different types, as shown in Fig. 3, to form sub-ceilings having both metal panels P and plasterboard panels C. It shall be

also understood that a further configuration may be envisaged, with reversely arranged panels with respect to Fig. 3.

The particular configuration of the beams 2 and interface members 5, 6 will allow the latter to be mounted to the load-bearing profiles 3 of the beams 2 without requiring any mechanical process such as riveting or the like, that might damage the beams 2.

Thus, the interface members 5, 6 may be also removed from the beams 2, and still maintain their structural integrity and allow remodulation of the sub-ceiling.

10 The support portions 20, 21 of the interface members 5, 6 may be configured in various manners known in the art.

For example, the support portion 20 of the interface members 5 may have a substantially horizontal flat surface 22, the panel C being fixed to its bottom by screw means or the like, not shown.

15 The support portion 21 of the interface members 6 is also configured in various manners known in the art.

Each of the anchor portions 18, 19 of each of the interface members 5, 6 comprises a substantially longitudinal and vertical flat formation 23, 24 having pairs of second lower and upper longitudinal projections 25, 26, transversely offset to each other by a second distance d_2 substantially equal to the first distance d_1 .

Thus, the second projections 25, 26 of each interface member 5, 6 may snap-fit with respective first projections 16, 16', 17, 17' of any connection element 15, 15'.

25 Advantageously, each of the flat formations 23, 24 of the interface members 5, 6 comprises a specially shaped lower appendage 27, 28, which is adapted to project out of the bottom opening 12 of the inner compartment 11 to define an extension of the vertical walls 4, 4' of the load-bearing profile 3 having the interface member 5, 6 mounted thereto.

30 Particularly, each appendage 27, 28 comprises a substantially longitudinal groove 29, 30 for receiving and holding a closure element for closing the compartment 11, which element has edges mating the shape of

said grooves.

The closure element, not shown herein and known per se, has a typical known configuration, with a flat formation of sufficient size to occlude the bottom opening 12 of the compartment 11, which has specially shaped edges for snap fit or sliding engagement with the grooves 29, 30.

According to a preferred, non-limiting configuration of the invention, as shown in Fig. 7, the system 1 also comprises one of more lower junction profiles 3, which are substantially longitudinal and have a predetermined width to allow transverse coupling of at least one pair beams 2, 2' in side-by-side relation with a gap therebetween.

The lower junction profile 31, as more clearly shown in Fig. 9, has a pair of mutually facing vertical walls 32 which are joined at their bottom by a substantially flat bottom wall 33.

The vertical walls 32 have respective specially shaped upper edges which are adapted for engagement with pairs of first projections 16', 16" of mutually facing lateral connection elements 15, 15" of two separate transversely adjacent beams 2, 2' of the plurality for mutual coupling thereof.

This allows direct coupling of two or more beams 2, 2' in a single sub-ceiling, for an even improved configurability of the system.

The vertical walls 32 of the lower junction profile 31 have respective portions designed to project at their bottom out of the bottom opening of the compartment 11 of the load-bearing profile 3 and having substantially the same height h as the specially shaped appendages 27, 28 of the interface members 5, 6.

Furthermore, each of the projecting vertical walls 32 of the first coupling profiles 31 have respective substantially longitudinal grooves 35 open on mutually opposite sides to face respective grooves 29, 30 of interface members 5, 6 and/or further lower junction profiles 31 to receive and hold the edge of a closure element for closing the compartment 11.

The system 1 may also comprise one or more substantially longitudinal upper junction profiles 36, one of which is more clearly shown

in Fig. 8, whose width is substantially similar to that of the lower profiles 31, for coupling to the mutually facing side walls 4', 4" of two separate beams 2, 2' in side-by-side relation, and allow firmer coupling thereof.

For this purpose, each beam 2, 2' has its own load-bearing profile 3, 3', whose vertical walls have respective third longitudinal projections 27, 27', 27", 27"', which are transversely offset to corresponding first upper projections 17, 17'.

Furthermore, the upper junction profiles 36 have specially shaped upper edges 38, which are designed for engagement with the third projections 37', 37" of the load-bearing profiles 3, 3' of the side—by-side beams 2, 2', and lower edges 39 which are designed for snap-fit engagement with respective first longitudinal upper projections 17', 17" of mutually facing load-bearing profiles 3, 3' of the same pair of beams 2, 2'.

According to a further particularly advantageous aspect of the invention, one or more of the beams 2, 2' of the system may be of the multifunctional type, as disclosed in the above mentioned patent application WO2009/153674, i.e. are adapted to receive one or more functional elements in the compartment 11.

As used herein, the term "functional element" shall be intended to indicate any element that can be introduced into the bearing profile 2 and has any function other than supporting the panels P, C or other elements belonging to the sub-ceiling structure with which the beam 2 can be associated.

For example, the functional elements are selected from lighting devices, such as lamps, sound devices, alarm devices or support elements for room partitioning elements, such as prefabricated panel walls, plates, curtains or the like.

Particularly, the inner compartment 11 of such multifunctional beams 2 is designed for stable and unremovable coupling with such functional elements, as taught in said application WO2009/153674.

For this purpose, the functional elements have a portion for attachment to the compartment 11, which is designed to hold the functional

element integrated in the load-bearing profile 3 and entirely held in the compartment 11.

The configuration of the functional elements will also comply with the teachings of the above mentioned international patent application, and will
5 not be described herein in greater detail.

With this combination of features, once the beam 2 of the invention is assembled, it will appear as a single body, with no parts projecting out of the exposed surface of the panels.

Likewise, the assembled sub-ceiling will have no structural element
10 projecting out of the plane defined by the exposed surfaces of the panels P, P'.

The functional elements are thus completely integrated in the sub-ceiling, thereby providing a high aesthetic quality as compared with prior art solutions.

15 The above disclosure clearly shows that the invention fulfills the intended objects and particularly meets the requirement of providing a modular system for sub-ceilings that ensures a highly flexible use and improved configurability as compared with prior art solutions.

The modular system of this invention is susceptible of a number of
20 changes and variants, within the inventive concept disclosed in the appended claims. All the details thereof may be replaced by other technically equivalent parts, and the materials may vary depending on different needs, without departure from the scope of the invention.

While the modular system has been described with particular
25 reference to the accompanying figures, the numerals referred to in the disclosure and claims are only used for the sake of a better intelligibility of the invention and shall not be intended to limit the claimed scope in any manner.

CLAIMS

1. A modular system for a sub-ceiling formed by a plurality of substantially horizontal panels placed in adjacent positions, wherein the system comprises:

- a plurality of beams anchorable to a ceiling in substantially horizontal positions and each having a substantially "U"-shaped cross section with a pair of lateral walls and a substantially vertical symmetry plane (π);

- a plurality of interface members adapted to be coupled with said lateral walls for anchoring of respective sub-ceiling panels to each of said beams;

wherein said interface members have quick connection means for snap connection to the outer side surfaces of said substantially vertical lateral walls;

wherein each of said beams has at least one pair of lateral connecting members outwardly projecting and each firmly associated with a respective substantially vertical lateral wall, each of said connecting members being integral with the outer side surface of the corresponding lateral wall; and

wherein said quick connection means comprise, for each of said interface members a substantially longitudinal anchoring portion for coupling with one of said lateral connecting members and a support portion adapted to support at least one panel.

2. Modular system as claimed in claim 1, wherein at least one of said interface members has a support portion adapted to support a sub-ceiling panel made of plasterboard, and at least one other of said interface members has a support portion adapted to support a panel in a metallic material.

3. Modular system as claimed in claim 1 or 2, wherein each one of said lateral connecting members comprises a pair of first longitudinal projections vertically reciprocally offset by a first predetermined distance.

4. Modular system as claimed in claim 3, wherein each of said anchoring portions comprises a substantially longitudinal planar formation with pairs of second longitudinal projections vertically reciprocally offset by a second distance substantially equal to the first distance for snap coupling with said first longitudinal projections of one of said lateral connecting members.

5. Modular system as claimed in claim 4, wherein said beams have an inner longitudinal compartment with a lower opening for introducing a functional member, said planar formation of each of said interface members having a shaped appendix that defines an extension of said vertical walls to project relative to said lower opening.

6. Modular system as claimed in claim 5, wherein each shaped appendix comprises a substantially longitudinal groove adapted to hold a closing element of said compartment with edges complementary shaped relative to said groove.

7. Modular system as claimed in any one of claims 4 to 6, comprising at least one lower substantially longitudinal joining profile with a predetermined width for connecting at least one pair of beams in transverse side-by-side relationship with an interspace, said profile being substantially U-shaped with a pair of facing vertical walls joined by a substantially planar bottom wall.

8. Modular system as claimed in claim 5, wherein at least one of said beams is a multifunctional beam having a structural member insertable into said compartment and an anchoring portion adapted to hold said structural member completely inside said compartment.

1/4

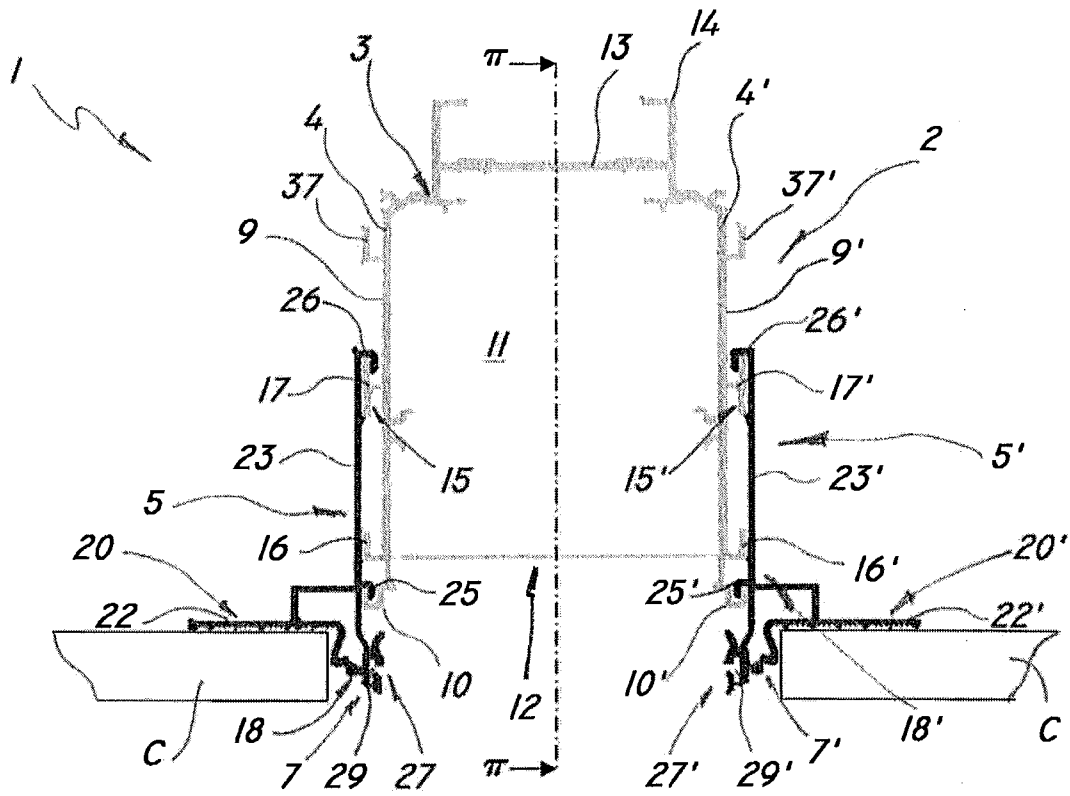


FIG. 1

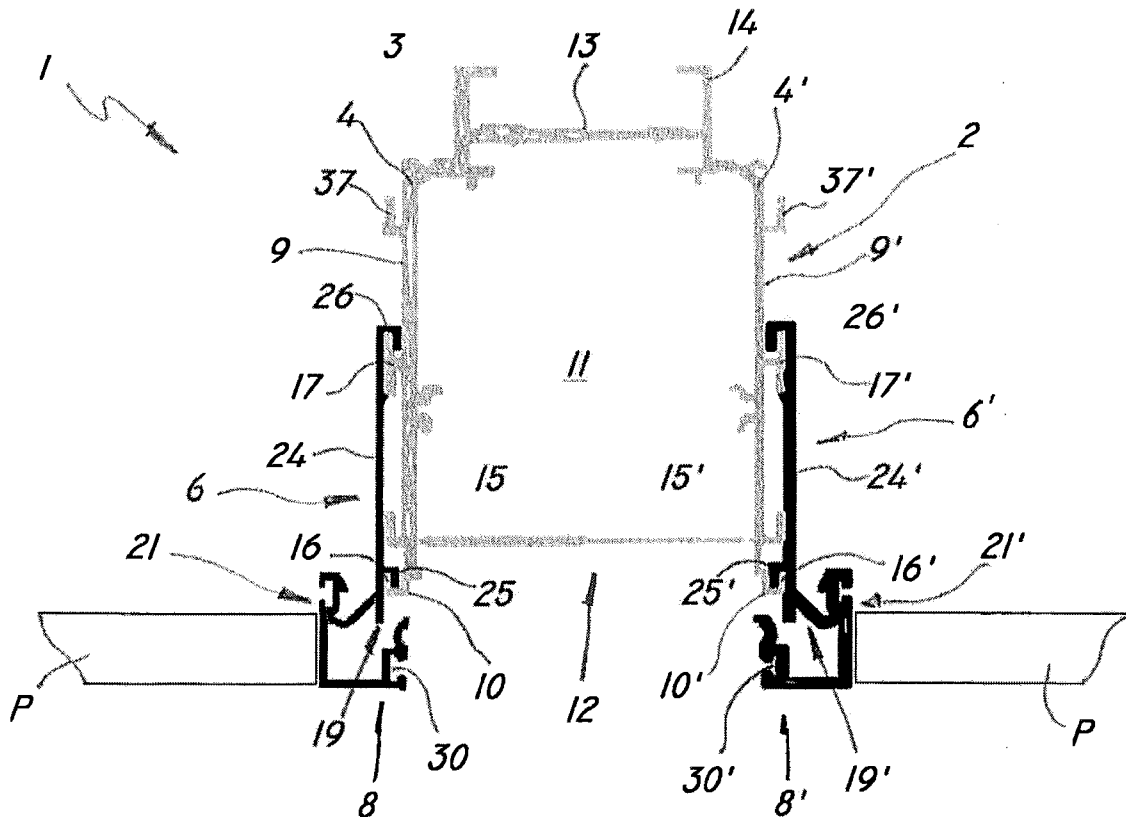


FIG. 2

2/4

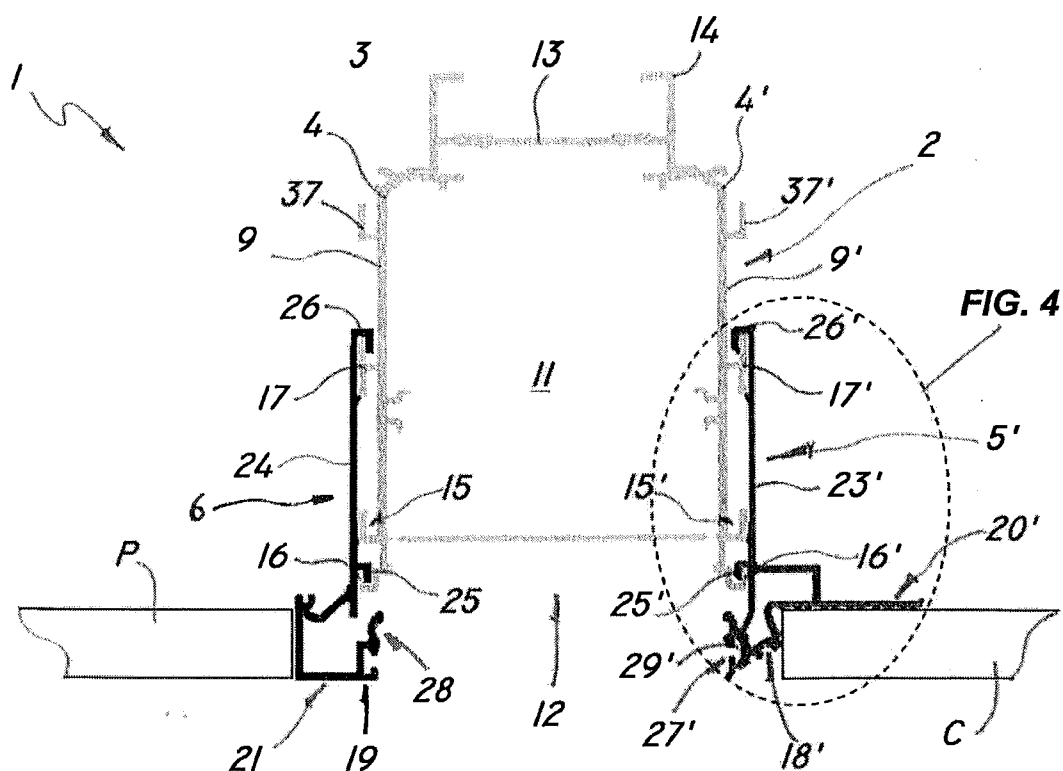


FIG. 3

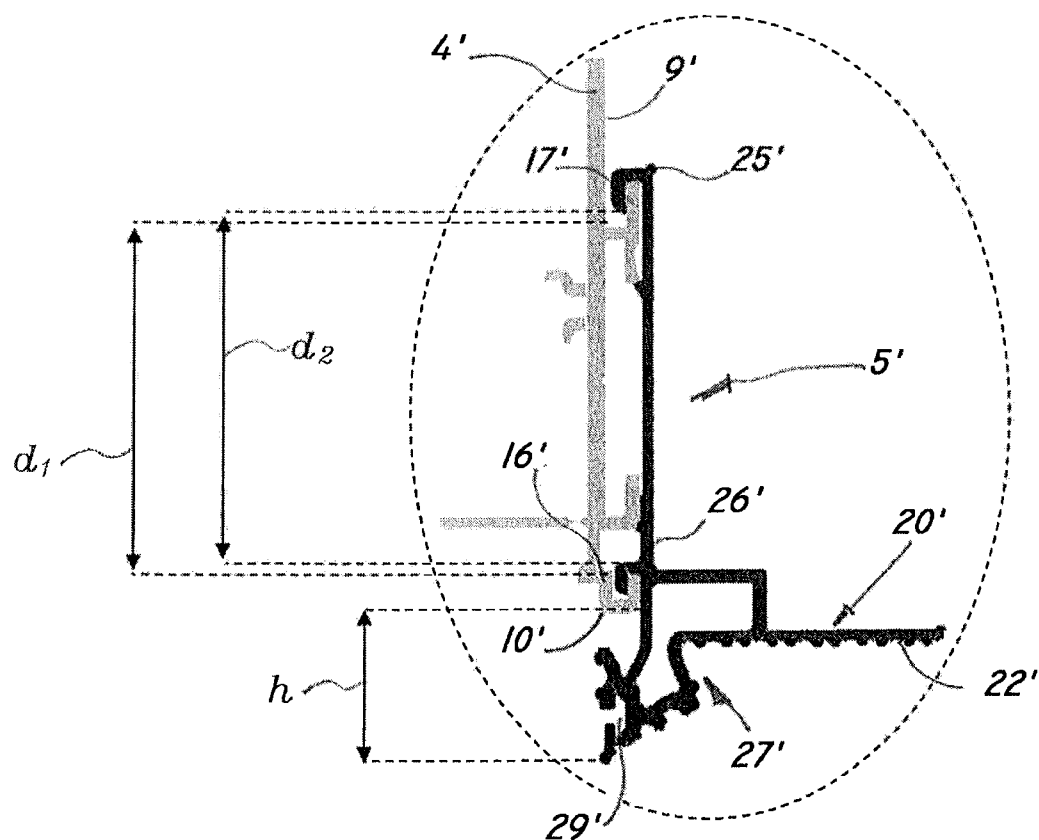


FIG. 4

3/4

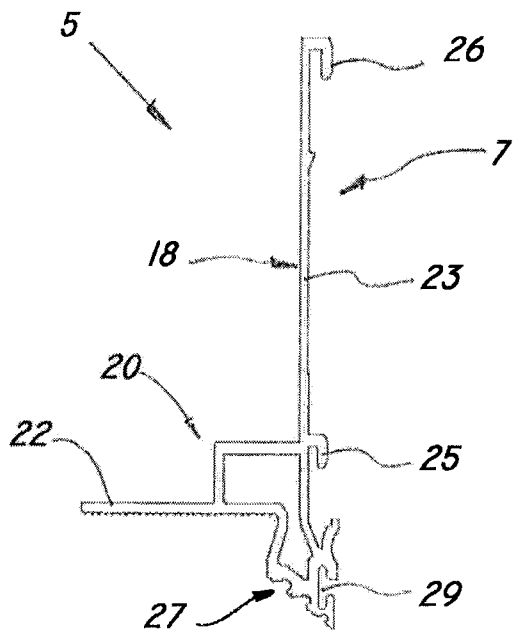


FIG. 5

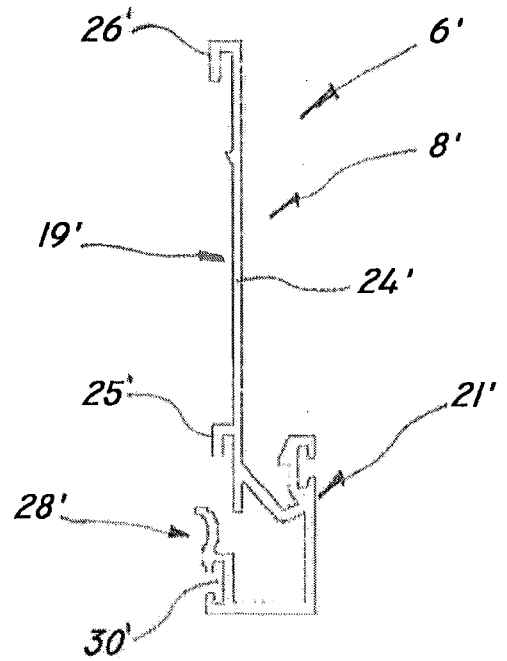


FIG. 6

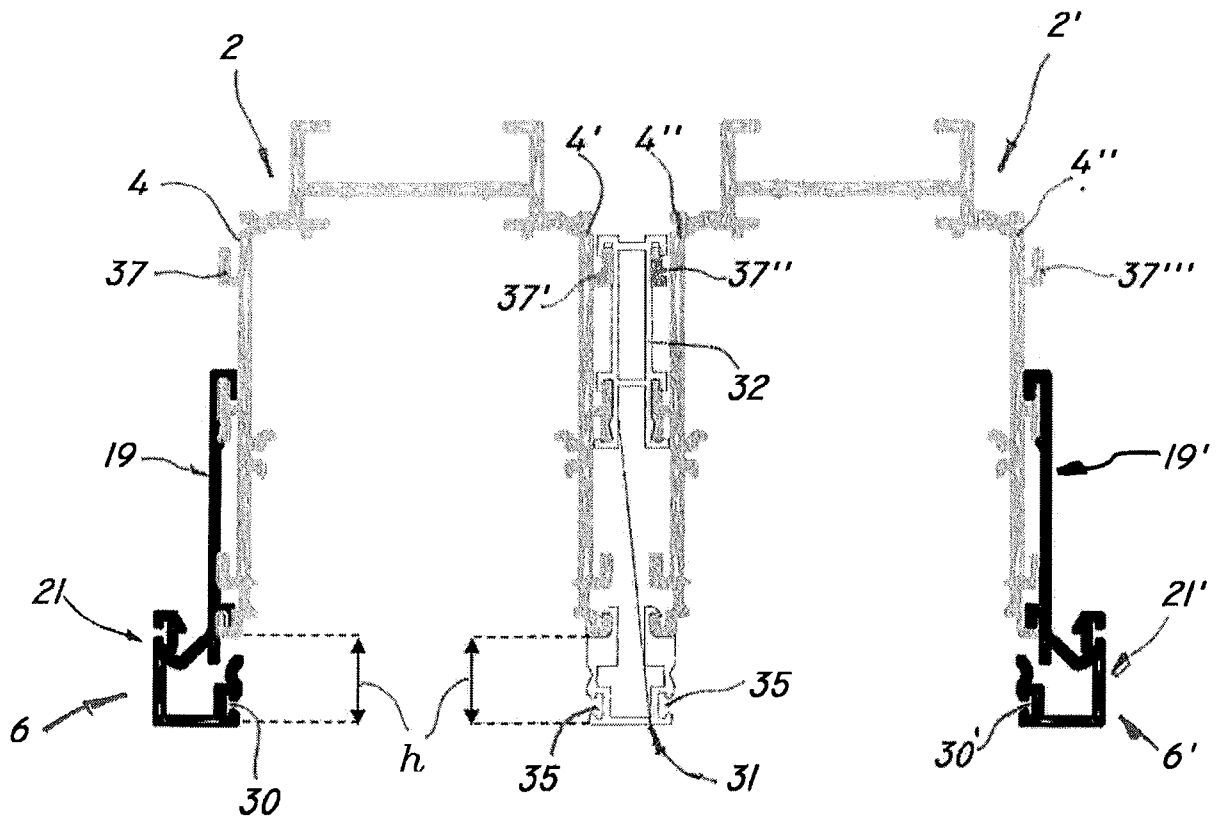


FIG. 7

4/4

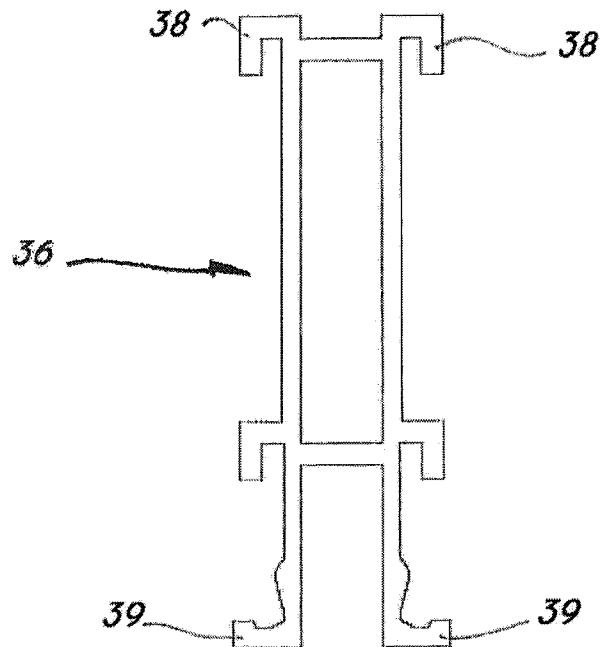


FIG. 8

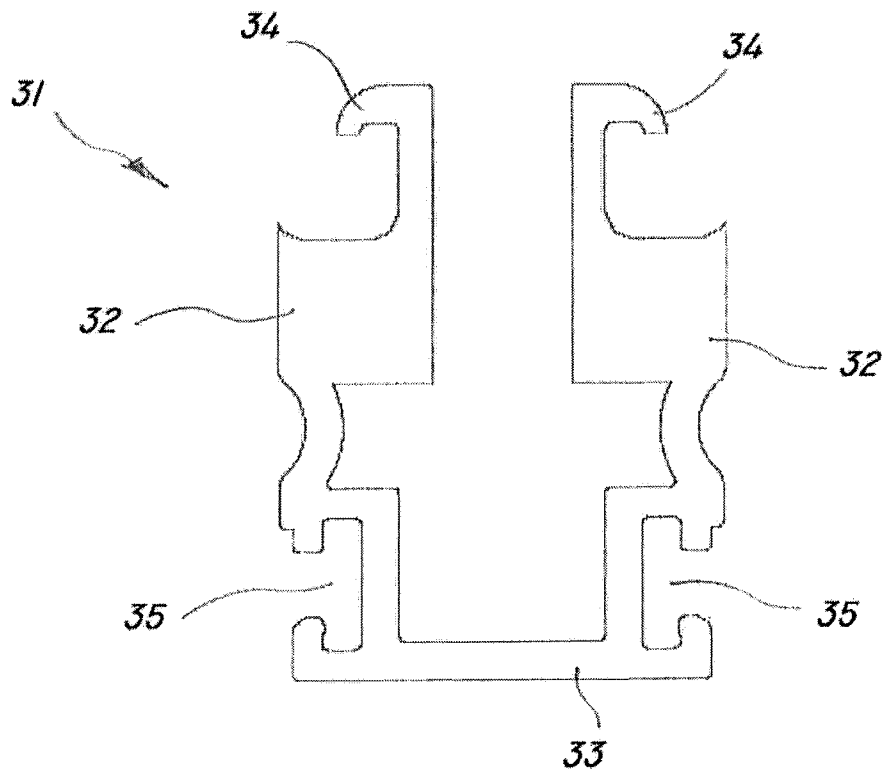


FIG. 9

